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APPLICATION OF EFFICIENT & RENEWABLE ENERGY TECHNOLOGIES IN LOW COST BUILDINGS AND CONSTRUCTION
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"A New Paradigm for Deep Sustainability: Biourbanism"

By

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ISB International Society of Biourbanism
www.biourbanism.org

Biourbanism

- Biourbanism introduces new conceptual and planning models for a new kind of city, which values social and economical regeneration of the built environment through developing and healthy communities.
- Biourbanism combines technical aspects, such as zero-emission, energy efficiency, information technology, etc. and the promotion of social sustainability and human well being.

Biourbanism and Green City

- Biourbanism endorses principles of geometrical coherence, Biophilic design, BioArchitecture, Biomimesis, etc. in practices of design and also new urban policies and, especially Biopolitics, to promote urban revitalization by ensuring that man-made changes do not have harmful effects to humans.
- Green city standards start inside the designs of each building and continue either in unbuilt spaces surrounding buildings or inside complex infrastructural networks, connecting buildings and people.
- New exciting developments recently, such as fractals, complexity theory, evolutionary biology and artificial intelligence are interrelated and constantly stimulate interaction between human beings and the surrounding built and unbuilt environment.

Biourbanism and Green City

- New Biophilic solutions in designs of buildings have been proved as attractive opportunities for new markets of housing.
- New infrastructural projects start embracing Biophilic advanced solutions which finally aim at energy efficiency and optimal performance.
- We find new innovative monitoring systems of building health emerging, not only in small scale, but also in large scale buildings, such as rail stations, for example, and commercial centres or even entire educational complexes integrated into new infrastructural projects.
- We shall present some case studies that they have been analysed and evaluated by Biourbanism and Biophilia principles and applied methods of design.

Definition Of Biourbanism

Biourbanism considers the city as a living organism; it studies it within the frame of Integrated Systems Sciences and the last advancements of Life Sciences, such as:

- **Laws of form and Self-organization in evolution;**
- **Epigenetics;**
- **Systems Biology;**
- **Constructal Law.**

Constructal Law and Biourbanism

Constructal Law: it has been introduced by Adrian Bejan, affirming that, *"Design is a universal phenomenon in nature. It is physics. It happens naturally when something is flowing and it is free to morph. Design unites the animate with the inanimate"* (Bejan & Lorente, 2013, p3).

"*Biourbanism* *focuses on the urban organism, considering it as a hyper complex system, according to its internal and external dynamics and their mutual interactions."* (Caperna, 2010, http://www.biourbanism.org/p2p-urbanism/, 01/07/2013)

Optimal forms of design

Biourbanism recognizes **optimal forms** defined at different scales (from the purely physiological up to the ecological levels) which, through morphogenetic processes, secure an optimum of systemic efficiency for the quality of life of the people living in cities. Designs, which do not follow these laws, as mentioned in the previous paragraph, may produce anti-natural and hostile environments, which do not fit into human beings' evolution, and thus, fail to enhance life by any means (Tracada & Caperna, 2012).

Morphogenetic patterns

Morphogenetic Design Processes, based on authentic recognition of optimal forms at different scales, are able to guarantee optimal systemic efficiency.

Research findings (Tracada, 2008) proved that, patterns of energetic lines, such as preferential paths, flowing and exploding in very ancient landscapes, had kept quite intact their evolving energy for many centuries and, perhaps they performed as generators of further expansion and development until recent and current times. These lines have always behaved as fractal everlasting emergences and have managed to influence and inform human behaviors and life in cities.

Patterns of exploding lines

Act

↑

Ak(c)-is

↑

Ak-

↑

Edge, boundary & rule

↑

Line pointing+piercing+penetrating into space

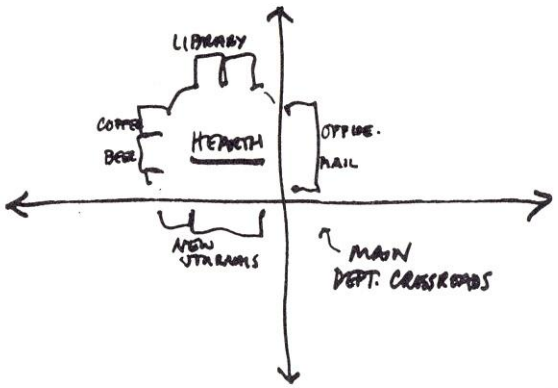
↑

Explosion of cosmic lines = Space/Ch-òros

↑

Core of energetic flows of people

Energetic power of crossroads

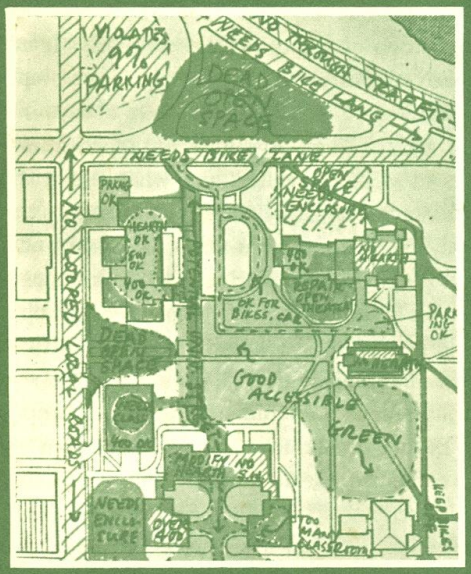


Centro di dipartimento situato ad un incrocio

christopher alexander

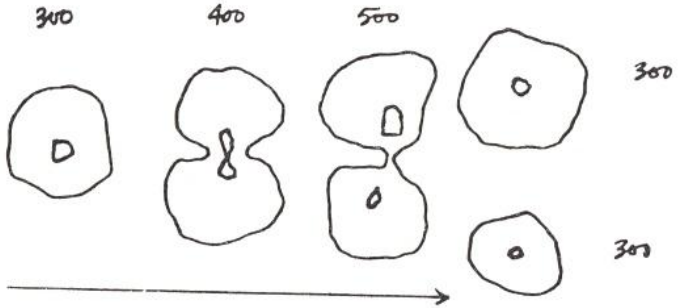
un esperimento di progettazione democratica

l'università dell'oregon

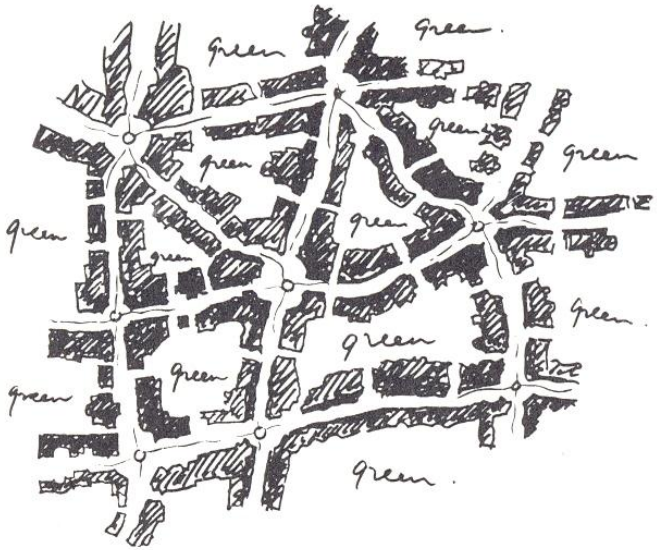


educazione / ambiente
officina edizioni
4.

Dati negli archivi dell'Oregon



Sviluppo di un nuovo dipartimento



Il tipo di struttura complessiva creato da questi sei patterns

Urban science and theories

- To understand how and why cities are successful or not, depending on their form, components and substructure;
- To discover principles underlying what we consider as phenomena and justify theoretical underpinning
- To justify the fact that a living city depends on an enormous number of paths and connections

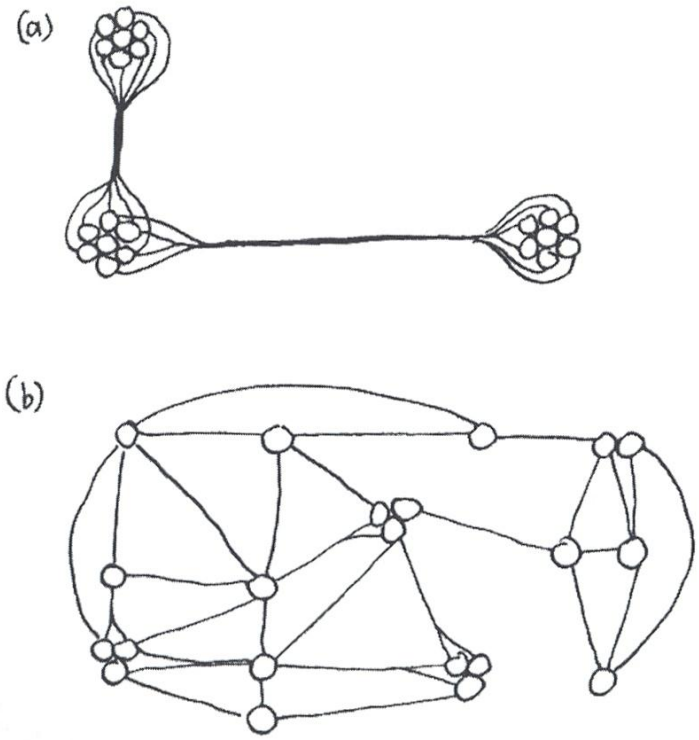
Urban science and theories

- The human mind establishes a deep connection with the environment by possessing geometrical information from its surroundings
- People recognise what looks and feels natural by its scaling hierarchy and also react accordingly
- The mathematical qualities of meaningful environments are those that manifest themselves in fractal subdivisions (an inverse-power distribution of sizes)

Urban science and theories

- Christopher Alexander's patterns encapsulate information about recurring design solutions and human activities.
- A pattern is a traditional and evolved solution.
- A city is understood as a complex interacting system.
- Coherent city form emerges from assembling components hierarchically, using intense local couplings together with long-range connections that reduce disorder

Connecting nodes of human activity



Connective paths are multiple and irregular:

a) Nodes are concentrated into three clusters with all connections forced into two channels

b) The same nodes distributed with connections that work much better (city and urban blocks)

(Salingaros, 2005 & 2008)

Complexity and Urban Coherence

- **Plasticity in urban form implies the presence of strong forces in the short range and weaker in the long range; that means plasticity forces act on urban elements (or urban components), connecting them (or better, coupling them).**

- **One of the most important basic eight rules of urban geometrical coherence is COUPLING.**

The idea of coupling

‘Order on the smallest scale is established by paired contrasting elements, existing in a balanced visual tension’

(Salingaros, 1995)

COUPLINGS: Strongly-coupled elements on the same scale form a module. There should be no unconnected elements inside a module.

The nature of strong links: coupling of boundaries/barriers in architecture

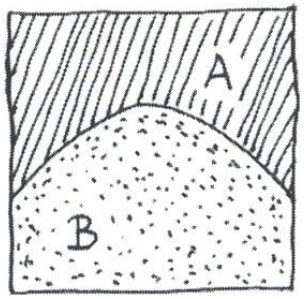


Fig 1. Geometric coupling through contrast in texture.

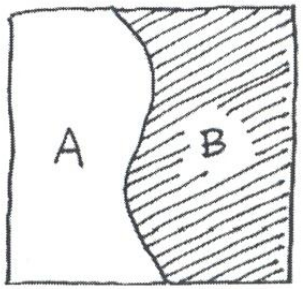


Fig. 2 Geometric coupling through contrast in color.

(Salingaros 2005 & 2008)

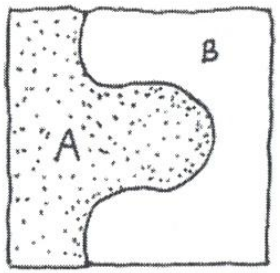


Fig. 3 Geometric coupling through interpenetration.

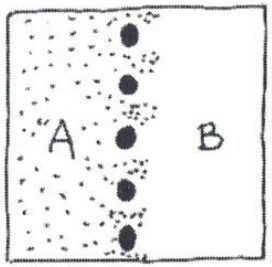


Fig. 4 Geometric coupling through permeability.

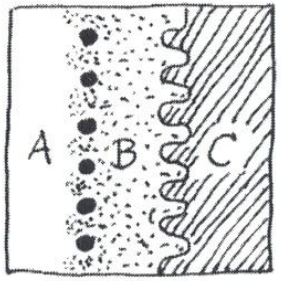
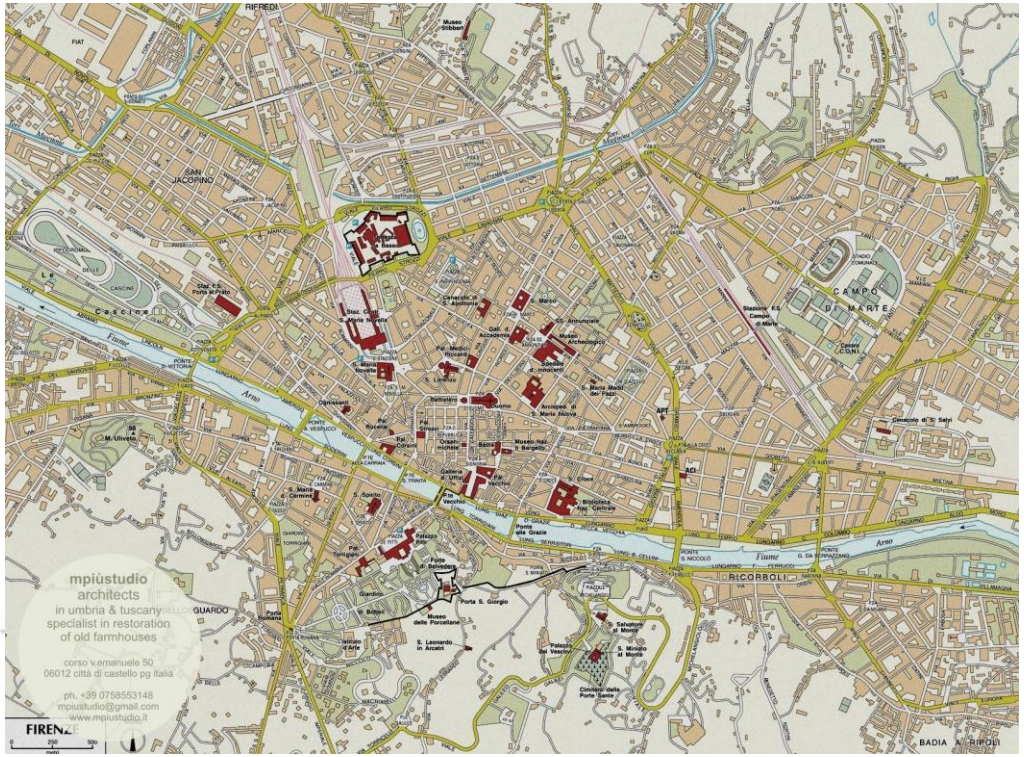


Fig. 5 Inductive coupling via a common third element.

Fractal coupling forces

‘Traditional urban geometry is characterised by fractal interfaces’

(Batty & Longley, 1994; Bovill, 1996; Frankhauser, 1994; Salingaros, 2005)



Maps of Florence, Italy

Fractal coupling forces

- Fractal is a structure that shows complexity at any magnification
- Continuous straight-line or plane boundaries and edges dividing one region from another are an exception rather than a rule in living cities
- ‘A successful urban interface resembles either a permeable membrane with holes to allow for interchange or a folded curtain with an edge that looks like a meandering river on a plan.’

(Salingaros, 2005)

A city may be decomposed in various ways, such as:

1. **Into buildings as basic units and their interactions via paths.**
2. **As a collection of paths anchored and guided by buildings (urban web).**
3. **As external and internal spaces connected by paths and reinforced by buildings (Alexander, 2002)**
4. **As the edges and interfaces that define spaces and built structures (Alexander, 2002 in *Complexity and Urban Coherence*)**
5. **Into patterns of human activity and interaction at urban edges and interfaces (Alexander, 1977 in *The Structure of Pattern Languages*)**

Connections by flow of people in open spaces

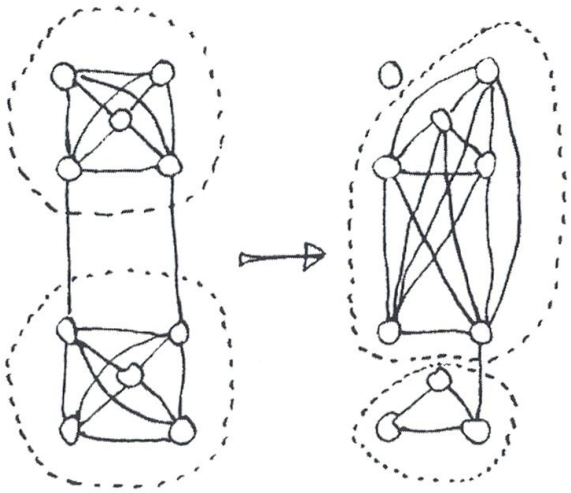


Fig. 8 Two modules reorganize themselves over time by defining new connections and new boundaries.

"Cities evolve their own organic/fractal form" **(Salingaros, 2005)**

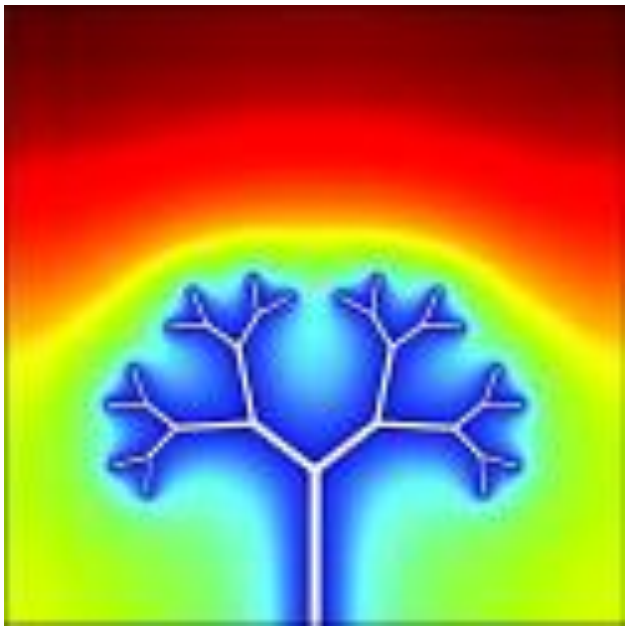
"Plans, patterns, symmetry, axes, are only of secondary importance relative to the fundamental processes that generate urban space. This lends support for the irregularity of successful urban spaces" **(Salingaros, 1999)**

Principles on optimal design

These principles relate to urban spaces and arrangements:

"*Minimum travel time is used in urban design, traffic, and transportation"* [or] *"minimum effort and cost is a core idea in social dynamics and animal design"* [or] *"maximum profit and utility is used in economics."* (Bejan & Lorente, 2013, p.2).

Designs are **tree-shaped** (Bejan & Lorente, 2013)



Tree-shaped architectures: ***"Constructal invasion of a conducting tree into a conducting body"*** **(Bejan & Lorente, 2013)**

Constructal Law

- ***"Life is flow: all flow systems are live systems, the animate and the inanimate."***

(T. Basak, (2011) The law of life: the bridge between Physics and Biology. Phys Life Rev 8, 249-252)

- **"Design generation and evolution is a phenomenon of physics."**

(L. Wang, (2011) Universality of design and its evolution. Phys Life Rev 8, 257-258)

- **"Designs have the universal tendency to evolve in a certain direction in time."**

N. Acuña, Mindshare. Igniting Creativity and Innovation Through Design Intelligence (Motion, Henderson, Nevada 2012).

CASE STUDY: Artena Village, Province of Rome, Italy

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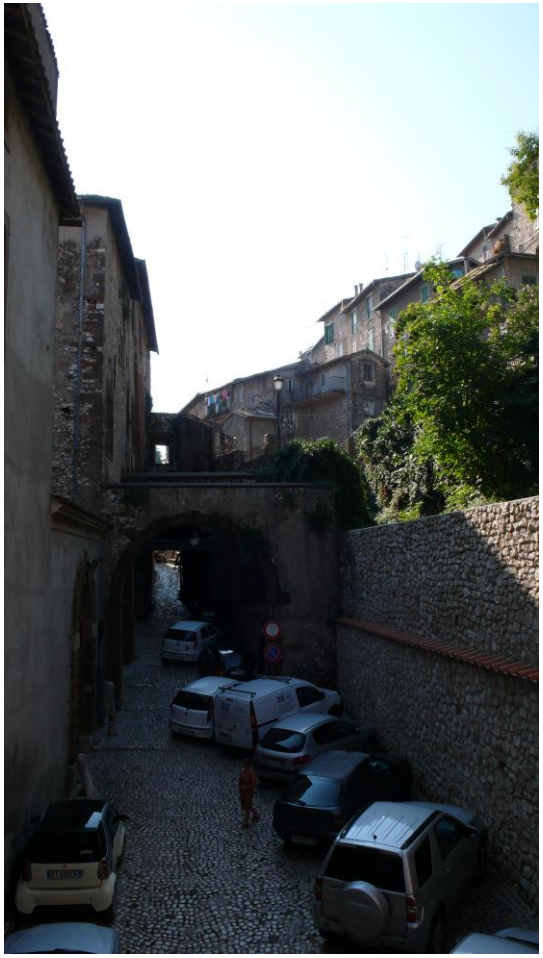

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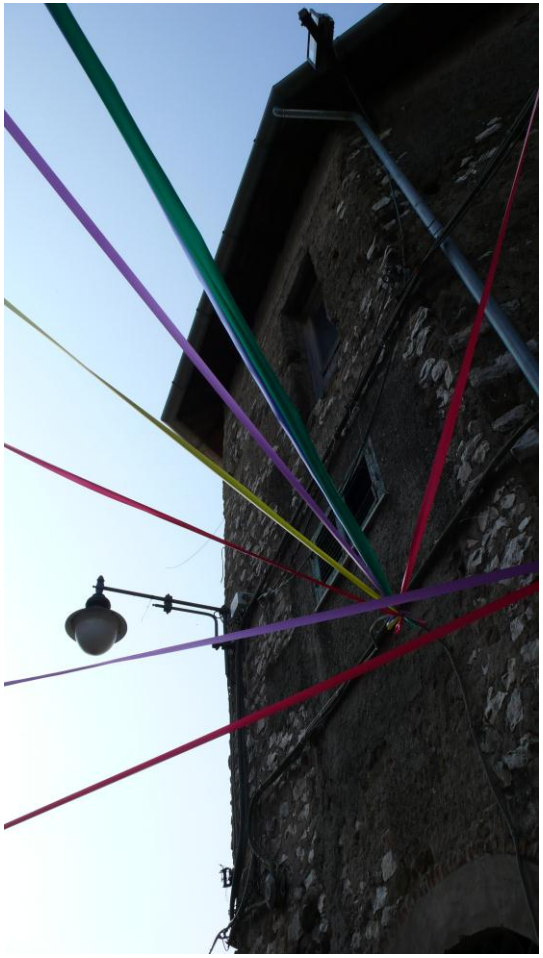
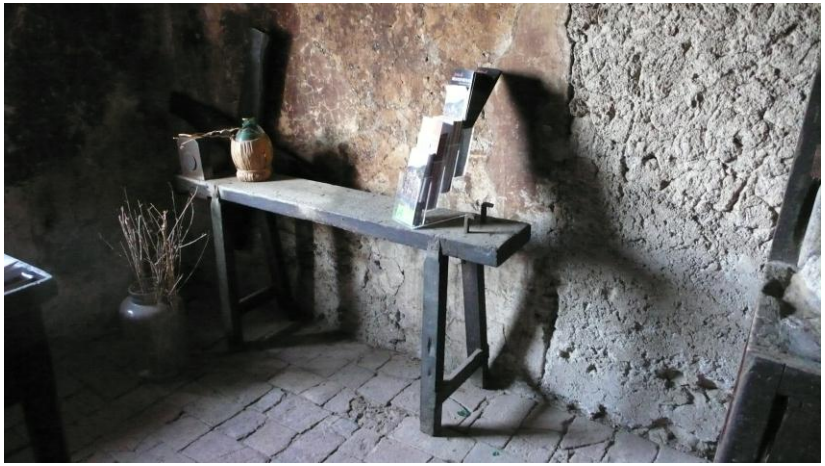


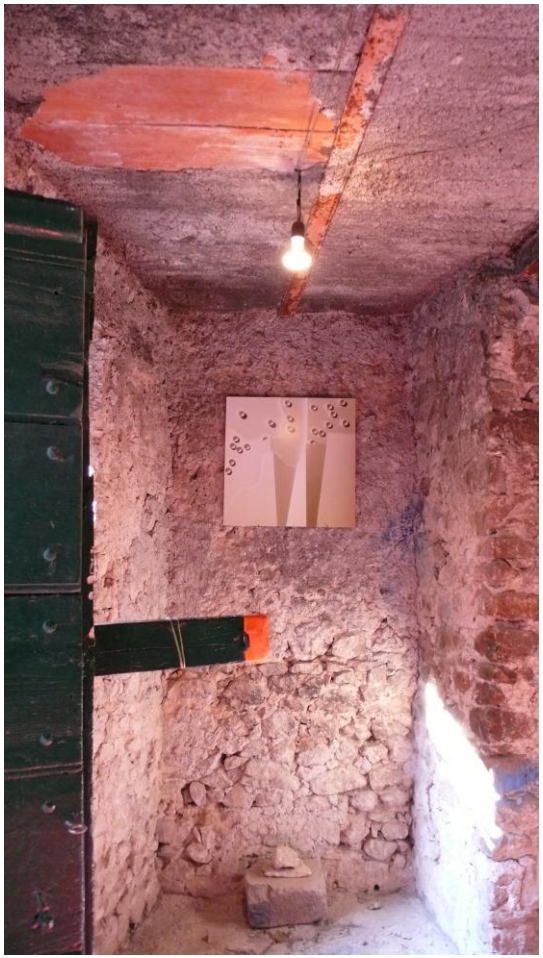
CASE STUDY: Artena Village, Province of Rome, Italy

"Ruin Academy"



CASE STUDY: Artena Village, Province of Rome, Italy

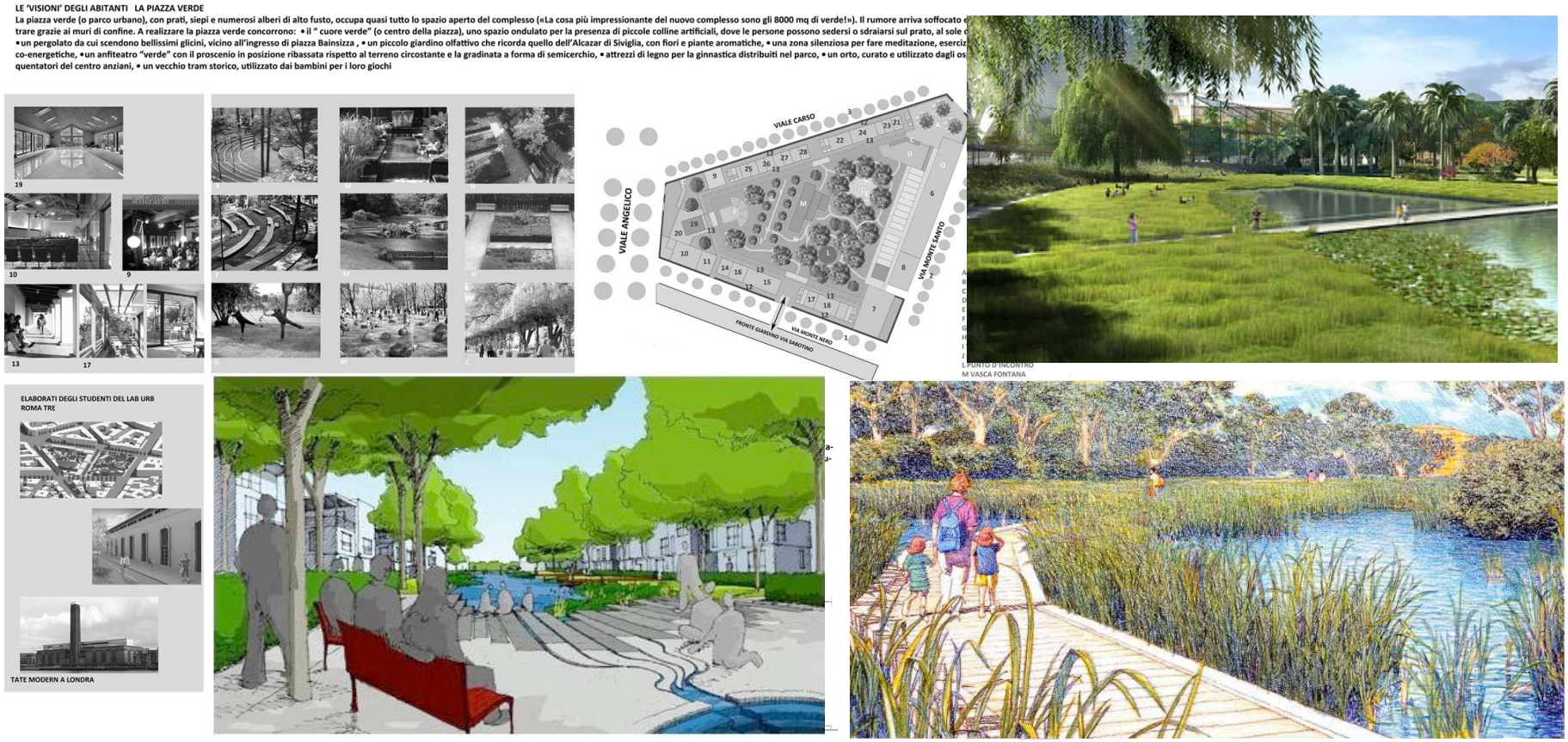
"Ruin Academy"



CASE STUDY: Artena Village, Province of Rome, Italy

"War Memorial Garden" – in bombed site during World War II

CASE STUDY: ATAC depot regeneration area in Rome



- The project above by Elena Mortola, Alessandro Giangrande et al. (Rome Tre University) adopts, by putting into practice, the theoretical corpus developed by Christopher Alexander and Nikos Salingaros.
- It was included and presented recently on 1st June 2013 by Dr. Stefano Serafini and Eleni Tracada in the workshop Biophilic Design. Theory and practice, in Environmental Design Research Association (EDRA) Conference, Providence44, USA.

Effects of fractal urbanism (design and planning)

We should be able to develop *"coherent and consistent dynamics of urban evolution which is built around the current fascination with the highly decentralized complex systems whose operation is at the local level, and which generates urban forms which are consistent with the fractal patterns that have been widely observed for cities"* (Batty & Xie, 1999).

Urban modules and connective forces

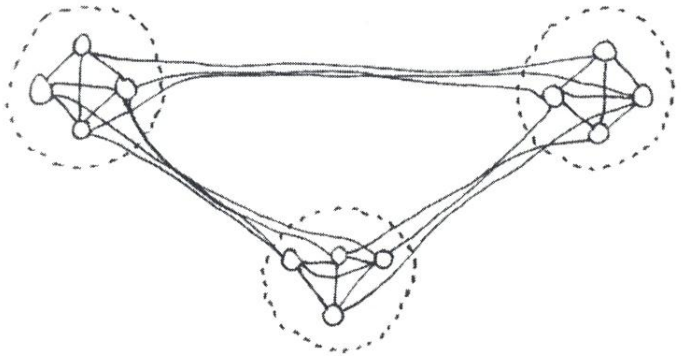


Fig. 3 Modules internalize connections between their constituent nodes. Three modules connect themselves via organizable forces.

Urban coherence is based upon stable modularization and urban modules are formed by connective forces; *"a module is any group of nodes (units) with a large number of internal connections…connections between internal nodes must be stronger than external connections"* (Salingaros, 2005); that is what happens, for example, in the Artena Village, at local level and with multiple fractal connections (in human life interactions and development of the built environment).

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Many thanks for your attention

Any questions?